# VITAMINE MALNUTRITION

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The great prevalence of malnutrition of children as presented by the studies of Dr. Josephine Baker and Dr. Thomas Wood has drawn our attention to this subject in a striking manner. According to Dr. Layton, "malnutrition includes whatever condition that tends to destroy health or cause abnormal functioning of the organs." Dr. Baker states that more than 1/5 of the school children of New York City are undernurished, while Dr. Wood places the per cent for the entire U. S. at from 15% to 25%.

This must not be interpreted that 3,000,000 to 6,000,000 children in the U. S. are not given enough to eat, but rather that for some reason, the food is not properly assimilated. This may be due to various causes, such as; lack of the proper quality or quantity of digestible food; bad eating habits e. g. poor mastication, washing down food with water, air which is bad and poor breathing habits. Other causes are; insufficient exercise and rest; uncleanliness, including neglect of the teeth, and irregular bathing. Physical defects and diseases under which we include mechanical obstruction, poor respiration and circulation; emotional disturbances and mental derangements are also causes of malnutrition. This is judged on the following basis; growth, condition of the body structures; bodily functions; vitality and verility. This paper will be confined to a study of malnutrition due to the lack of certain kinds of food, more especially those known as

"Vitamines".

Before 1897 the food requirements of the body were thought to be protein, carbohydrates, fats, mineral salts and $H_2O$ only, but in the recent years, it has been found that these are not the only requirements. To Eijkman must be given the credit for the first fertile suggestion as to the nature of the dietary fault which was responsible for the development of beri-beri. This being a very common disease among the poorest classes of the Orient, who live principally on the limited food supply of polished rice and fish. He found that by feeding pigeons on polished rice exclusively, they developed polyneuritis, which is a state of paralysis analogous to beri-beri in man, usually within three or four weeks. He likewise found that feeding the rice polishings to the pigeons suffering from polyneuritis gave adequate cause for prompt recovery (1). The birds feeding on the whole rice kernel, he observed, did not always develop the disease. These experiments of Eijkman received little attention until 1911, when Dr. Funk took up the study of beri-beri, giving special attention to the attempts of isolation and study of the curative substance in rice polishings.

Funk also made use of the experiments Fraser and Stanton made in 1907. They found that the alcoholic extracts of rice polishings would relieve experimental polyneuritis. However, an erroneaus assumption seemed to prevail in this work, that

the polishings consisted essentially of the removal of the outer covering or bran layer of the rice kernal, when as a matter of fact the rice germ is in a very exposed position and is easily rubbed off during the polishing.

F. G. Hopkins of Cambridge, England, in 1912 suggested a new veiwpoint. After a series of feeding experiments he suggested that milk contained a certain unidentified food substance which, when added to the given amount of protein, fats, carbohydrates and mineral salts, would not only aid in maintainance of body weight, but also made growth possible. To these substances in milk he gave the name "accessory articles of diet".

From these works of Eijkman, Fraser, Stanton and Hopkins, as well as the work in his own laboratory, Funk developed the well-known "vitamine" hypothesis ($1^2$). This hypothesis postulated the existence of a similar protective substance for each of the diseases scurvy, pellegra and rickets, in addition to that which in the normal diets protects against beri-beri. He had expermental evidence in the case of beri-beri only, for his theory, and since then, much of his theory has been doubted or discredited by others.

$M^c$ Collum and Davis have done much experimenting along this line, resulting in very valuable findings. They tried feeding rats on a mixture of "purified" food-stuffs with the addition of a little butter fat, and succeeded in securing growth, but when they added vegetable fat or the body fats of animals, the rats did not grow. Thus they arrived at the conclusion that

aside from the long recognized constituents of the normal diet, there is some unknown substance in butter fat which must likewise be furnished in the food (1[3]). They began a systematic investigation of the problem of growth and its relation to certain unidentified food properties, which brought out some very interesting facts which will be dwelt on more fully later.

"The term "vitamine" therefore, refers to one or more substances of unknown composition, extremely small amounts of which are necessary for normal nutrition." Many attempts have been made to isolate vitamines in a pure state, but so far all attempts have failed. Our knowledge of this class of substance is therefore, still limited almost intirely to the physiological effects they produce.

Atherton Seidell of the U. S. Public Health Service, Washington D. C. says, "It is neither a salt nor a protein, is soluble in water and alcohol. It is dialyzable and is distroyed by heating to 130°C. Some of the attempts made to isolate the pure vitamine may be of interest at this time. Funk and others have shown that it is not distroyed by hydrolysis for 24 hours with 20 % $H_2SO_4$. Funk at first reported that the crystalline material he succeeded in isolating from rice polishings, yeast, milk, and bran by acid precipitation and subsequent decomposition of this precipitate, was the antineuritic vitamine. Later he was forced to abandon this position and

retraction was made of the claim that isolation of the curative substance had been effected.

An experiment of great interest was performed by activating Fuller's Earth with Vitamines. To remove the Fuller's Earth it was found necessary to use a dilute alkali. The aqueous solution thus obtained from the "activated Fuller's Earth" was found, by physiological test, to contain only about ½ of the total vitamine originally present in the solid. By evaporation of the solution, the resulting material does not possess the appearance or character which a pure product would be expected to show.

Both vitamines and enzymes readily form absorption compounds. This would indicate that vitamines possess the same colloidal type of structure as is believed to be common to enzymes. On the other hand it has been found that the antineuritic vitamine dialyzes readily through parchment paper. This raises a doubt as to the colloidal character of the antineuritic vitamine.

A characteristic of vitamine which may be considered is the ease with which the activity is destroyed in alkali solution. The only test of the activity of a vitamine, however, is by means of a living organism (2).

"Nobody has ever seen a vitamine, perhaps nobody ever will. Nor is it certain how the vitamines operate in nutrition. Whether they supply certain chemical units to the body or are mere stimulators of assimilation of the true foods is quite

uncertain. They are like the atoms and electrons of physical science, in one respect at least, that, though they have never been isolated and their nature is mere matter for conjecture, reasoning can be based on their operations and beneficial, practical results deduced."

One widely accepted fact concerning vitamines, is that there are three types, namely: Fat soluble A, water soluble B and water soluble C. We will discuss the vitamines in the above order.

Dr. H. Gideon Wells of the Department of Pathology of the U. of Chicago, who served in Roumania under the Red Cross, shows a most tragic condition resulting from the lack of the Fat soluble A vitamine. The scanty diet in Roumania when he arrived, consisted of a little more than a limited amount of corn meal and quantities of a very thin bran-vegetable soup. The Austrians had driven off the cows so there was no milk or butter. The result was that many of the children had eye diseases, some cases were so severe that the children were already blind. War-edema, a very distressing swollen condition also existed. This was probably due to low calories and especially the low protein of the diet. Dr. Wells heard of a vessel of cod-liver oil which had been put into Archangel. This through the efforts of the Red Cross, he succeeded in getting, and it saved the lives of many of the children. After their long fat starvation, they took readily what they might have

refused under other circumstances. (9)

Dalyell, who was with Chick in Vienna for a number of months, speaks of a girl who had been having only 10 to 15 grams of milk fat daily and who developed severe eye trouble. She was given 10 grams cod-liver oil and 20 grams butter daily and in 14 days not only had her eyes completely recovered but she had gained 300 grams in weight also. (10)

Mc Collum states that the specific result of a lack of a sufficient anount of the Fat soluble A in the diet is the development of a condition of the eyes which appears to be rightly classed as a type of xerophthalmia. The eyes become swollen so badly that they are opened with difficulty or not at all. The corner becomes inflamed and unless the missing dietary essential is supplied, blindness speedily results. ($1^4$)

This condition has also been observed by Osborne and Mendel in experimental animals in which cases butter fat was added to the diet of which five or more per cent caused a prompt recovery when given within a few days of death. Complete recovery takes place within two weeks if the sight has not been distroyed, but if it has, it is still possible to recover a normal condition of the eyelids. ($1^5$)

Mori in Japan described in 1904, 1,400 cases of xeroph-thalmia among children in a time of food shortage. He attributed it to fat starvation, and by feeding chicken livers, affected a cure. He states that the disease does not occur among fisher folk. Mc Collum states in this case that it seems

highly probable, however, that a lack of fat was not in itself tha cause of the disease, but rather the lack of the unidentified dietary issential which is associated with certain fats. (16)

Bloch has recently described 40 cases of severe necrosis of the cornea with ulceration, from the vicinity of Copenhagen. The children had been fed fat-free separator skim milk and were atrophic or dystrophic and anemic. He thought it was fat starvationbecause the children recoverd when fed breast milk or whole milk mixtures or when cod-liver oil was administered.

By some authors, it is believed that rickets is also a result of a deficiency of the Fat-soluble A vitamine, but others disagree, saying it is a nutritional disease, but that its relation to the diet is not yet clear. It is characterized especially by an alteration in the growth of the bones. These become enlarged at the extremities and so soft that they bend under the stress of muscular contraction and under the weight of the body. Various deformities of the head, spine, chest and limbs result as the child develops. (18)

Some English investigators believe that rickets is the result of a deficiency of an "anti-rachitic vitamine" which is synonymous to Fat-soluble A(11), Mc Collum, Sunmonds and Parsons say that low fat-soluble A, low calcium, poor protein, unsatisfactory salt combinations, acting together may all contribute to cause rickets (12).Mellanby, one of the cheif supporters of the anti-rachitic vitamine theory, finds that, "When the diet has a relatively good protein content and the animal

is active, less antirachitic accessory factor is necessary. However, it seems very necessary to do further investigation with rickets before its etiology is completely established.(13) Ellwood Hendrick says, "Cod-liver oil has long been known as a cure for rickets, and cod-liver oil is rich in the Fat-soluble vitamine A."

In a discussion on tuberculosis, Elwood Hendrick offers the considerations in regard to the disease. "Tuberculosis is a zymotic disease, but the war has emphasized that if we do not feed enough fat to human beings they become immediately and singularly susceptible to contagion, and that consumption becomes a veritable epidemic if we cut the fat supply too low. A question yet to be decided is whether tuberculosis does or does not follow a deficiency in diet of the Fat-soluble A vitamines, more specifically than a general deficiency of fats." (3)

This problem is being worked on by experiments with animals, and it is hoped they will have it determined before long. It seems likely that all fats; whether they contain the vitamine A or not, help to ward off tuberculosis, but this is not definitely known as a fact. However, the diet prescribed is milk and eggs, and such foods as are particularly rich in that vitamine known as Fat-soluble A. But we can catch tuberculosis even while we are living almost entirely on a diet of milk and eggs, so it is best not to generalize too much

concerning the relation of tuberculosis and the Fat-soluble A vitamine.

Capt. Robert Dollar when a foreman and general medical man as well as boss of a lumber camp, noted a peculiar disease in which the victim was blind at night but could see in the daylight. This he called "Night Blindness". He cured this disease by making the patient eat cheese and drink milk freely for a week. Capt Dollar attributed the disease to a monotous diet, but it has since been found to be due to the lack of the Fat-soluble A vitamine. (4) Mc Collum substantiates this veiw.

The Fat-soluble A vitamine occurs in many different kinds of foods and is much more abundant than was formerally thought. The most important sources thus far discovered are butter fat, milk, cream and eggs. The amount of vitamines in milk and butter depends on the food of the cow and the manipulation of the butter itself.(15) The milk is richer in this vitamine in the spring, when the cows are put out to pasture, and poorer in winter milk when they are on dry feed.(14) Ellwood Hendrick says, "Fat-soluble A vitamine is taken from food and deposited in such glands of animals as the liver, but it is not deposited in the muscles, except when the animals have been fattened on abundant grass food, and even then it is scarce. It is not produced inthe body of any animal.(4) Osborne and Mendel found that Oleo oils contain a fair amount of it and

the oleomarganines made of the oleo oil do, but not the nut margarines or those made entirely from vegetable oils.(16) Whale oil, cod-liver oil, in fact fish oils and fat fish contain this fat-soluble A and pig's liver (11) oil and liver tissue, kidney tissue as do probably all glandular organs in general. (17)

Altho most authorities do not include vegetable oils among their sources for the Fat-soluble A, still Daniels and Loughlin have found very distinct amounts in lard and cotton-seed oil, shown only when large quantities are fed. (18) Likewise, Drummond and Coward noted its presence in palm oil as much as one third of that present in butter and still less in maize oil and cotton-seed oil. (19)

Many of the vegetables are also rich in this vitamine, altho all are not agreed as to their relative importance as yet. Dried spinach, alfalfa, clover, timothy and tomato promote growth of rats just as satisfactorily as an equal small quantity of butter fat; possibly they are even better. Cabbage is not so good; potato comtains only a small quantity. Some of the storage organs of plants as well as the leaves are accredited with this substance. Thus we have carrots, sweet potatoes, and even yellow corn given by some. Peas and possibly bananas contain some. (20) (21) (22)

Mc Collum does not verify all of these. He says, "The seeds and seed products, such as wheat flour (bolted), de-

germinated corn meal, polished rice, starch, the sugars, syrups, tubers, roots, such as the radish, beet, carrot, turnip etc. do not contain enough to be classed as important sources of the dietary essential." ($1^9$)

Steenbock made the generalization concerning the yellow colormater and vitamines. He said that the Fat-soluble A vitamine is one of the carotinoid pigments or a closely related compound. (5) Leroy S. Palmer disapproved this generalization by raising a flock of chickens from hatching to maturity on a diet free, or at most containing the merest traces of carotinoids but containing an abundance of A in the form of carontinoid-free pork liver. Not only did the mature hens lay eggs whose yolks were free from carotinoids, but a second generation of carotinoid-free chicks were hatched from them. He concluded that either the Fat-soluble vitamine requirements of fowls differs from that of mammals or the yellow plant pigments and Fat-soluble vitamine are not related physiologically. (6)

The stability of the vitamine is of great interest here. Steenbock, Boutwell, Kent (15) and Drummond (23) found that the Fat-soluble vitamine in butter fat is readily destroyed by heating at $100^{o}$ for one to four hours and partially destroyed at even lower temperatures. Drummond also observed that the hydrogenation of the whale oil at $250^{o}$ for four hours completely destroyed A. Even heating at $100^{o}$ for an hour had the same effect, or keeping it for eighteen days at $37^{o}$ spread out

exposed to air. Butter heated to 120° without aeration was satisfactory, but when the air was passed through during the heating, destruction of A seemed complete.

Light, too, is an important cause of destruction of A, maybe the most important cause. (24)

Water-soluble B is the next class of vitamines to be considered. There seems to be a very striking relation between the presence of the vitamine in the diet and the amount of food eaten. Karr tried in Mendel's laboratory giving dogs a liberal ration, having all requirements except water-soluble B supplied. (25) (26) The result was the almost complete loss of appetite after a few days. Then he added the vitamine but this was given separate from the food, so it could not have affected the palatability, and they began to show signs of a normal appetite, eating more and more. Another pecular fact noted concerning these dogs, was that the coefficient of digestibility for the protein eaten without the vitamine was not dimenished, nor was there any notable irregularity in the intermediary protein metabolism. This was indeed contrary to conclusions drawn by others.

Mc Carrison, working in India, noted changes during life and loss in weight of organs after death in a large group of pigeons made polyneuritic by a polished rice diet, and later a group fed on the same diet with butter fat added to supply the Fat-soluble A and onion to supply the Water-soluble C.(27)

The general effect seems to be much the same when deprived of water-soluble C as when suffering from a general vitamine starvation. The body temperature fell gradually, from 107°F to 98° or 99°F, which is indicative of a slowing up of metabolic processes. Digestive processes were greatly impaired; the starch was not digested, being largely excreted unchanged. The different organs of the body, especially the ductless glands were affected and lost weight strickingly, (all except the adrenals which gained); thymus most, then inorder, testicles, spleen, ovary, pancreas, heart, liver, kidneys, stomach, thyroid, brain. "Perhaps one of the most remarkable results of a dietary deficience in so-called anti-neuritic vitamine is the constant and very pronounced atrophy of the testicles im males and the similar but less pronounced atrophy of the ovaries in females."

In human subjects, such degrees of atrophy would result in sterility in males and in amenorrhoes and sterility in females. (28) (29)

Mc Carrison noted miscellaneous infections frequently. Ellwood Hendrick reports that a deficiency of the Water-soluble B in the diet often shows itself in boils, acne and other skin eruptions. A speedy cure is often effected by the addition of Water-soluble B. Its absence has no effect on infectious skin diseases, except that it lowers the powers of resistance to infection. (3)

Mc Carrison's statement of some of the "cheif clinical

evidences of diseasc", observed in monkies on diets without this anti-neuritic vitamine will be partially quoted: progressive anemia, asthemia, loss of appetite, diarihea, dysentery, headache, sub-normal temperature enfeebled heart action, with nervous symptoms appearing later. Perhaps the effects of the lack of vitamines on the geresal health may give a clue to the causes of many of the vague ill-health conditions and espedially the languor, usually spoken of as "Spring Fever" which so universally exists after the long winters on canned fruits and vegetables and dried foods; the effects on the vitamine of drying, canning and ageing will be noted later.

Having noted many general effects, we will now consider beri-beri, one of the "deficiency diseases". Mc Collum states: "Beri-beri and xerophthalmia are the only diseases referable to faulty diet which are to be explained this way. (1[7]) It is a disease of the nervous tissues, in which fat gloubules form in the nerves. As the disease progresses, it affects the heart, and eventually every tissue of the body. Its most striking characteristic is a general paralysis. It is very painful and is fatal unless a substance containing Water-soluble vitamine B is administered. When produced experimentally in animals it is referred to as polyneuritis. A most rapid cure may be affected by the feeding of this water-soluble vitamine B. (3)

Let us here consider where this substance is found and

some of its peculiarities. It was first discovered by Eijkman in 1897 in rice polishings which affected a cure for polyneuritic in pigeons, but the substance was not named until 1911 when Funk began his work. Since then it has been found present in milk and animal tissues such as heart, kidney, brain and liver.

The occurrence of this vitamine in plants is very satisfactorily given by Osborne and Mendel. Their list includes a wide variety of plant foods, including seeds of cereal and a number of legumes, spinach, cabbage, potatoes, carrots onion, turnip, beets(leaves, stem and roots) and tomatoes. (30) Potato peel is not better than potato. Immature alfalfa, clover and timothy show decided advantages over the mature. It is thought that this variation with age may be applicable to young vegetables in general and may mean that young vegetables are far superior to old ones in real nutritive value.

Fruits are very rich in vitamine B also. Orange, lemon and grape fruit juices promote about the same fate of growth as an equal volume of milk, the dried orange juice being as effective as fresh. The inner peel of the orange also contains it. (31) Some other fruits as apples, pears and bottled grape juice are not as rich in it as the citris fruits. Nuts afford an abundant supply. All the common vegetables and fruits so far tested have shown its presence. The germ of the cereal and not the bran is the part which is richest in the Water-

soluble B. Graham bread made from real graham flour affords an adequate supply.

Yeast is distinctly the richest known source of this vitamine, being four times as efficient as dried spinach. (33) Whole wheat, soy beans, dried eggs, milk solids and cabbage are only about half so valuable as the spinach.

Of the milk, pasteurization does not lower the quantity of the Water-soluble vitamine, and condensed and evaporated milk also furnish a satisfactory supply. (34) The removal of the calcium instead of the vitamine is the reason why slowly or highly heated milk sometimes seems deficient. (35)

The Water-soluble vitamine B is probably not so stable toward heat as was formerly supposed. (36) This is shown when food supplying B has been fed in the smallest amounts possible to promote growth, at all, when heated above 100° does cause deterioration as it must be fed in much larger proportions afterwards than the raw food to promote the same amount of growth.

Wheat germ, heated two hours at 100° loses little or none of its potency, heated forty minutes at 113° it loses one-half and heated two hours at 118°-124° it may lose up to nine-tenths. These temperatures point to the safety of this vitamine in our ordinary cooking processes, but shows the danger of its partial or complete distruction in commercial canning or other high pressure cooking. (37) Both Miller and Whipple found that in ordinary cooking of carrots, beans and cabbage

there was destruction of B. A large part of the vitamine in ordinary cooking was found in the cooking water. (38) (39) This vitamine has a remarkable resistance to alkali as was shown by the experiments of Osborne and Wakeman who fed rats on alkali meat for at least 110 days before they finally died. (40)

The Water-soluble Bivitamine is not produced within the human body. This is clearly shown by the experiment made by Doctors Gibson and Concepcion in the Philipines. They found a number of nursing mothers among the colony of Filipinos, who had developed beri-beri from their diet of rice. A number of the mothers had lost their little ones, and many of those who were not yet dead, were suffering from beri-beri like their mothers. Several of the mothers who had lost their children were induced by the physicians to nurse young puppies for a short time. They, likewise, were affedted with the disease, until the mothers diet was changed and their milk ceased to be defective. (3)

Our third and last vitamine under consideration is the one known as "Water-soluble C" or"Antiscorbutic". Without a sufficient amount of this substance, the condition known as scurvy results.

In severe cases, the bones and blood vessels are affected. The joints swell, and stiffen, while in almost all tissues occur hemorrhages. (3) The teeth become loose and fall out, while the gums become sore and are subject to hemorrhages. (41)

This condition of the teeth is particularly characteristic. Sometimes these conditions of the teeth and gums in the guinea-pig closely resemble pyorrhea in human beings. (42)

In less severe cases, the symptons may be only languor and depression.

Some authoritoes do not substanciate the antiscorbutic vitamine theory. Jacksnn and Moore not only maintain that scurvy is a bacterial disease, but they even have experimental evidence of such. Diploccocus has been found in the hemorrhagic joints by them, and they say it may have a causal relationship to the disease. ($1^{10}$)

Mc Collum and Pitz maintain that scurvy is the result of the mechanical difficulty which the animals have in the removal of feces of an unfavorable character from this part of the digestive tract. These conclusions were drawn after administering of liquid petrolatum, a "mineral" product with absolutely no food value, with satisfactory results. The animals, when almost dead from the disease, were relieved without further change of diet. ($1^{11}$)

There are two sources of Water-soluble C; fruits and vegetables and animal foods. Among the fruits and vegetables we have it in the largest amounts in fresh fruits and green vegetables, and a small amount in root vegetables and tubers. Oranges are very valuable as antiscorbutics, both the juice ans orange peel extract being used. Lime juice is poor in it,

while grapes are only about 1/10th as good as oranges. (43) Raw cabbage is very valuable, also raw juices of swede, beetroot, carrots and the juices of cooked rhubarb. (44)

This vitamine is not very stable;cooking diminishes or entirely destroys it as a rule, except when th vegetables are young. Thus we see the entire loss of long cooked or canned vegetables, in the respect. Canned tomatoes are an exception. (45) This is probably due to their acidity and original richness in the substance. From pototoes we may get quite a good supply if they are not cooked too long. Drying, especially of vegetables, greatly lessens their value in this vitamine. Tomatoes, oranges and lfmons are not effected by drying. (46) (47) (48)

The resistant power during the drying process, is somewhat dependent on the method employed. It usually does least harm when young vegetables are used and it is done quickly at a high temperature. (47) Givens and Mc Cluggage suggest that enzyme action is involved in the destruction of the antiscorbutic vitamine as well as heat. (49) Some foods, such as dried beans, otherwise valueless, develope their vitamine on sprouting.

This vitamine is not very prevalent among animal foods. Milk is only of moderate value, and even this amount varies with the diet of the cow. When the cow is out on the pasture the amount is greatest. Pasteurized (50) or boiled milk looses practically all of its valur, and commercially condensed milk

is valueless (51) and so is dried milk also, unless dried very quickly. (46)

A very small amount is present in fresh meat, but in no appreciable amount. (52)

Another possible theory of the result of a vitamine deficient diet is the effect on the teeth. This has been noted by Mc Collum and Pitz, Cohen and Mendel and others. Although they have not attributed the trouble to any special vitamine, they firmly believe it is a vitamine deficience which causes the guinea-pig's teeth to become loose and the bleeding and congested condition of the gums. Mrs. May Mellanby produced irregular teeth in pups by rachitic feeding. When Zilva and Wells examined some guinea-pigs' teeth, histologically, which had been fed on a scorbutic diet, they reported degenerate changes both in the teeth and in their pulps. (7)

In conclusion, it is well to note that, owing to the newness of the subject, there is still much controversy over various theories, and thus much room for further research and experiments, however, some few facts have been generally established and agreed on.

There are at least dietary accessories present in food called vitamines A, B, and C which are essential to growth and the maintainence of health if certain diseases of malnutrition are warded off. That a deficiency of Fat-soluble A results in xeropgthalmia and night blindness is a generally accepted fact.

Two other diseases, rickets and tuberculosis, altho not purely deficiency diseases, are attracting much attention along this line at present, but so far the concensus of opinion is that a deficiency of Fat-soluble A is only one contributing factor among several others.

When Water-soluble B is not present, it has been shown that some of the following result: loss of appetite, slowing metabolic processes, digestive processes impaired, the ductless glands are affected and loose weight, headaches, nervousness etc. are some of the more general effects, while beri-beri is the result in severe cases.

The efficiency of this vitamine is not affected by the ordinary cooking processes, altho heated for two hours at 118° to 124° makes it loose about nine-tenths its original value. This vitamine has a tendency to escape into the cooking water, which shows the necessity of using as little water as possible. It is remarkably resistant to alkali.

The water soluble C--antiscorbutic vitamine is the one which is supposed to cure scurvy. As yet, there remains a great deal of discussion as to whether scurvy is really a deficiency disease or not. The latest authorities who have written on the subject disapprove the vitamine theory, and the present concensus of opinion is that it is caused by a lack of minerals rather than a vitamine deficiency.

This vitamine is very unstable in the presence of heat, drying of ageing.

The following table shows the amount of all vitamine A,

B, and C contained in food. The stars indicate much or little according to the number of stars from one to three, the dashes indicate absence and the question marks indicate doubt as to presence or absence of the vitamine. (8)

| FOODSTUFF | A | B | C |
|---|---|---|---|
| alfala | ** | ** | |
| clover | ** | ** | |
| timothy | ** | ** | |
| whale oil | * | | |
| turnips | -- | * | |
| grapefruit | -- | * | |
| yeast | | ** | |
| nuts | | ** | |
| grapes | -- | -- | * |
| milk | ** | ** | * |
| butter | *** | -- | -- |
| cream | ** | * | * |
| separated milk | * | ** | * |
| egg yolk | *** | ** | ? |
| egg white | -- | ? | --? |
| beef fat | ** | -- | -- |
| lard | -- | -- | -- |
| animal fat, margarines | * | -- | -- |
| vegetable oil, margarines | -- | -- | -- |
| lean meat | -- | -- | *? |
| liver | ** | ** | |

| FOODSTUFF | A | B | C |
|---|---|---|---|
| heart, kidneys . . . . . | * | * | |
| pancreas . . . . . | * | ** | |
| brain. . . . . | * | ** | *? |
| "lean" fish, e.g. cod. . . | ** | -* | |
| "fat" fish, e.g. herring . | * | * | |
| fish roe . . . . . | * | ** | |
| Cod-liver oil. . . . . | *** | -- | -- |
| fish-body oils . . . . . | ** | -- | -- |
| wheat, whole grain . . . . | * | ** | -- |
| wheat, embryo or germ. . . | * | *** | -- |
| wheat, endosperm . . . . . | -- | -- | -- |
| wheat, bran. . . . . | -- | * | -- |
| rice, polished . . . . . | -- | -- | -- |
| rice, whole grain. . . . . | * | ** | -- |
| white bread. . . . . | -- | -- | -- |
| whole wheat bread. . . . . | * | ** | -- |
| yellow corn. . . . . | -- | * | -- |
| white corn.. . . . . | * | * | -- |
| yeast, dried . . . . . | *? | *** | -- |
| cabbage, fresh . . . . . | * | * | *** |
| cabbage, dried . . . . . | * | * | -- |
| spinach. . . . . | ** | * | *** |
| potatoes . . . . . | -- | ** | ** |
| sweet potatoes . . . . . | ** | * | ? |
| oranges. . . . . | -- | * | *** |
| lemons . . . . . | -- | * | *** |

| FOODSTUFF | A | B | C |
|---|---|---|---|
| rhubarb | -- | -- | *** |
| tomatoes | ** | * | *** |
| onions | ? | -- | *** |
| apples, green | ? | -- | *** |
| carrots, young | * | ** | *** |
| carrots, old | * | * | * |
| rutabagas | -- | ** | ** |
| dasheens | -- | ** | ? |
| red beets | -- | ? | * |
| lettuces | ** | ? | *** |
| peas, dry | ? | * | -- |
| peas, fresh | * | * | *** |

THE END

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